

ANKLE BRACE WITH CUFF AND STRAP

BACKGROUND OF THE INVENTION:

This application is a continuation-in-part of and claims priority from Patent Application PCT/US00/03385 filed February 9, 2000, which is a continuation of U.S. Patent No. 6,053,884, filed February 18, 1999, (Priority date of 18 February 1999) and it claims priority from U. S. Provisional Patent Application SN 60/283,893 (Ankle Brace with Strap Attachment), filed April 13, 2001.

The present invention relates to ankle braces, and, in particular, to an ankle brace that provides greater comfort and support than braces of the prior art.

Many types of ankle braces are known, including my earlier design, described in U.S. Patent Re. 33,395. That brace provided greater flexibility and comfort than other braces, because it provided pivots on both sides of the brace, which enabled the foot to flex forward and backward while limiting side-to-side motion of the foot relative to the leg in order to protect the injured ankle. That brace had left and right pivot legs, which were intended to lie along the left and right sides of the wearer's leg, and there were straps which wrapped around the leg to hold the pivot legs together. While the straps provide flexibility of movement, they also stretch and shift, thereby sacrificing some structural support.

Also, in prior art designs, the semi-rigid stirrup encircled the bottom of the foot, interfering with a person's foot spreading out as he put his weight on the foot, thereby causing irritation and pain. If the stirrup were made wide enough to avoid that problem, it would provide less support to the person's ankle and might be too wide to fit into the person's shoe.

SUMMARY OF THE INVENTION:

The present invention provides the desired front-to-back flexibility of the prior art braces, and, in addition, provides improved structure so that there is additional structural support preventing side-to-side movement of the ankle.

In particular, most of the preferred embodiments of the present invention provide arms, extending from the left and right pivot legs, which are joined together

to form a flexible rear cuff. The phrase "flexible rear cuff" means a rear cuff that provides greater flexibility than would be provided by joining the arms together to form the cuff as a unitary piece having substantially the same thickness, continuity, and height as the arms themselves. The flexibility may be achieved by cutting out portions of the unitary rear cuff to make it substantially more flexible, or by changing the dimensions of a portion of the unitary rear cuff so that it is substantially thinner or shorter than the arms, or both, thereby creating a substantially more flexible section.

Also, if the arms are not formed as a unitary piece, the mechanical arrangement by which the arms are joined together to form the cuff may provide the flexibility. For example, in one preferred embodiment, the arms are connected together by a rivet which permits them to pivot relative to each other. This pivot connection allows the brace to be adjusted in order to fit a wide variety of people's foot and leg shapes, resulting in a comfortable brace, while providing more support than prior art designs.

The arms, pivoted together, limit the range of motion between the pivot legs while providing the desired flexibility so that the wearer can continue to flex and exercise the ankle while the ankle is protected and supported by the brace. Most of the other embodiments use other mechanisms for providing a controlled, flexible connection between the arms.

The preferred embodiments of the present invention also provide a heel stirrup and a tongue, extending forward of the heel stirrup. The heel stirrup surrounds the heel to provide the greatest possible stability while leaving the bottom of the foot, including the arch, free to spread out, so that the stirrup does not impinge on the wearer's foot.

The preferred embodiments of the present invention also provide an ankle brace with a single strap closure mechanism that provides the wearer easy enhanced structural support, adjustability for ankle size, and ease of use.

BRIEF DESCRIPTION OF THE DRAWINGS:

Figure 1 is a perspective view of an ankle brace made in accordance with the present invention, with a wearer's foot shown in phantom;

Figure 2 is a side view of the ankle brace of Figure 1;

Figure 3 is a front view of the ankle brace of Figure 1;

Figure 4 is a rear view of the ankle brace of Figure 1;

Figure 5 is a top view of the ankle brace of Figure 1;

Figure 6 is the same view as Figure 1, but with padding added to the interior of the brace;

Figure 7 is a view taken along the section 7-7 of Figure 6;

Figure 8 is a rear view of a second embodiment of an ankle brace made in accordance with the present invention, with a separate, slotted rear cuff (peeled back to depict how it attaches) which provides flexibility and adjustability;

Figure 9 is the same view as in Figure 8 but with the rear cuff attached at both ends;

Figure 10 is a top view of the rear cuff of Figures 8 and 9;

Figure 11 is a rear view of another embodiment of an ankle brace made in accordance with the present invention, with an integral, slotted rear cuff which provides flexibility and adjustability;

Figure 12 is a partially broken away top view of the left rear cuff portion of Figure 11;

Figure 13 is a partially broken away top view of the right rear cuff portion of Figure 11;

Figure 14 is a rear view of another embodiment of an ankle brace made in accordance with the present invention, with a separate pivotable rear cuff;

Figure 15 is a view taken along the line 15-15 of Figure 14;

Figure 16 is a rear view of another embodiment of an ankle brace made in accordance with the present invention, with a separate flexible rear cuff;

Figure 17 is a perspective view of another embodiment of an ankle brace made in accordance with the present invention, with the closure strap removed;

Figure 18 is a side view of the ankle brace of Figure 17;

Figure 19 is a view along the line 19-19 of Figure 18;

Figure 20 is a front view of the ankle brace of Figure 17;

Figure 21 is a back view of the ankle brace of Figure 17;

Figure 22 is a front view, similar to Figure 20, of another embodiment of an ankle brace made in accordance with the present invention;

Figure 23 is a back view of the ankle brace of Figure 22;

Figure 24 is a perspective view of either of the ankle braces of Figure 17 or 22, with the closure strap in place;

Figure 25 is a broken-away perspective view of the ankle brace of Figure 24 before the strap is fed through the slot extension of the left pivot leg;

Figure 26 is the same view as Figure 25, except that the closure strap has been fed through the slot extension of the left pivot leg in preparation for tightening the strap onto itself;

Figure 27 is a side view of the ankle brace of Figure 22, with the strap shown securing the ankle brace to the wearer's leg;

Figure 28 is a the same view as Figure 19, but with the strap in place as in Figure 27;

Figure 28A is a view identical to that of Figure 28 except that it shows the closure strap adjusted for use with a larger ankle;

Figure 29 is a front view of the brace of Figure 27; and

Figure 30 is a rear view of another embodiment of a brace made in accordance with the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS:

Figures 1-5 show an ankle brace 10, which is made up of three main pieces. The first piece is the heel stirrup 12, which is substantially U-shaped, and includes a base or bottom portion 14 and left and right upright portions 16, 18. The upright portions 16, 18 project upwardly and forwardly from the rear of the base portion 14, which permits them to wrap around the heel, which provides for the greatest support, while still locating the pivots 26, 28 adjacent to the ankle, to provide the greatest comfort and flexibility. The horizontal distance "A" from the axis of the pivots 26, 28 to the rear of the stirrup 12 preferably is at least one inch. The horizontal distance "B" from the rear edge of the upright portion 16 at the height of the pivot 26 to the rear edge of the base 14 preferably is at least 0.75 inches. This location of the upright portions 16, 18 also prevents the stirrup 12 from interfering with the spreading of the foot. A tongue 20 extends forward from the forward edge 14A of the bottom portion 14 of the stirrup 12 to provide additional support, again without interfering with the foot. The entire stirrup 12, including bottom portion 14, upright

portions 16, 18, and tongue 20 are preferably molded or otherwise formed from a single piece of material. It would, of course, be possible to use separate pieces of material and connect them together to form the stirrup 12, but a single piece is preferable.

The second and third pieces are the left and right pivot legs 22, 24, which are pivotably connected to the left and right uprights, 16, 18, respectively, at the left and right pivot points 26, 28. The pivots 26, 28 are formed from bolts, rivets, or other connectors extending through the respective uprights and pivot legs, as shown best in Figure 3 and are located approximately at the location of a wearer's ankle, so that the brace pivots forward and backward with the person's ankle. The two ankle pivot points 26, 28 preferably are at the same height. As shown in Figure 2, the axis of the pivots 26, 28 is directly above the forward edge 14A of the bottom portion 14 of the stirrup 12. Also, as shown in Figure 3, there preferably are spacers or washers 30 between the connected uprights and pivot legs to prevent them from rubbing against each other as they pivot.

The left and right pivot legs 22, 24 have rearwardly-projecting arms 32, 34, which overlap each other and are fastened together with a bolt, rivet, pin, or other connector to form a rear pivot point 36. The rear pivot point 36 is located along an imaginary vertical plane bisecting the brace 10, and its axis of rotation is substantially orthogonal to an imaginary vertical plane extending through the two ankle pivots 26, 28. A rear cuff 38 is formed by the two rearwardly-projecting arms 32, 34. The left pivot leg 22 and left arm 32 preferably are formed of a single piece of material, and, even if they are formed of separate pieces, it is preferred that the arm 32 be made of material at least as rigid as the leg 22 to which it is attached. This is also preferred with respect to the right pivot leg 24 and right arm 34.

A strap 40 is fastened at one end to the right pivot leg 24 and includes a strip of hook-and-loop fastener on its free end, and there is a mating piece of hook-and-loop fastener fixed to the left pivot leg 22, so that a wearer can put the brace on and then wrap the strap 40 around the front of his leg and fasten it to the left pivot leg 22 to hold the brace 10 on.

The brace 10 is shown here being used on the wearer's right foot, but the identical brace 10 could also be used on the left foot, as the brace is essentially

symmetrical about a central vertical plane.

Figures 6 and 7 show the brace 10 of Figures 1-5 modified by the addition of padding 50 on the interior surface of the legs 22, 24 and arms 32, 34 of the brace. While these drawings show the use of foam padding, many different types of pads, including air pillows, gel packs, and so forth, may be used.

Figures 8 and 9 show another embodiment of a brace 10A, in which the left and right rearwardly projecting arms 32A, 34A do not quite overlap each other. Each of the arms 32A, 34A has a plurality of slightly curved, substantially vertically-oriented slotted openings 52A. A separate rear cuff member 38A, which preferably is made of a material that is more flexible than the material of the arms 32A, 34A, has a plurality of mating, substantially-vertically-oriented, elongated ridges 54A projecting from its inner surface (See Figure 10). These ridges 54A are designed to mate with the slotted openings 52A of the left and right rearwardly projecting arms 32A, 34A. By selecting the slotted openings into which the ridges 54A are inserted, the rear cuff 38A provides an adjustable-length bridge between the two pivot legs 22A, 24A. This arrangement also allows some flexibility of lateral movement of the leg when it is braced within the ankle brace 10A, both by movement of the ridges 54A along their respective slotted openings 52A, and by flexing the rear cuff 38A itself. The shorter the length of the ridges 54A relative to the length of the slotted openings 52A, the more lateral movement of the leg is allowed, while still not permitting the horizontal separation between the two pivot legs 22A, 24A to increase significantly, thus maintaining the leg secured within the ankle brace 10A.

Figure 11 shows yet another embodiment of an ankle brace 10B. In this embodiment, the left and right rearwardly projecting arms 32B, 34B do overlap each other, and one arm 32B has a plurality of substantially-vertically-oriented, arcuate slotted openings 52B, while the second arm 34B has a plurality of substantially-vertically-oriented, elongated ridges 54B projecting from its outer surface (See Figures 12 and 13). As in the case of the previous embodiment of the ankle brace 10A, the ridges 54B are designed to mate with the slotted openings 52B such that the rear cuff 38B provides an adjustable-length bridge between the two pivot legs 22B, 24B, and also allows some flexibility of lateral movement of the leg when it is braced within the ankle brace 10B. This ankle brace embodiment 10B works in a

very similar manner to that of the previous embodiment 10A; namely, the shorter the length of the ridges 54B relative to the length of the slotted openings 52B, the more lateral movement of the leg is allowed while still not permitting the horizontal separation between the two pivot legs 22B, 24B to increase significantly, thus maintaining the leg secured within the ankle brace 10B. The width of the cuff is adjusted by selecting the slots 52B into which the projections 54B are inserted. As shown in Figure 11, the cuff is at its narrowest adjustment. To make it wider, only the two outermost projections 54B will be inserted into the two outermost slots 52B, and, to make it wider still, only the one outermost projection 552B will be inserted into the outermost slot 52B. To adjust the amount of flexure that is permitted, the manufacturer adjusts the length of the projections 54B relative to the length of the slots 52B. The greater the difference between the length of the projections and the length of the slots, the greater the amount of flexure that is permitted.

It should also be noted in Figure 10 that the projections have a slight taper along their edges, so they are wider at their outer edge than at the point where they connect to the base, in order to help hold them into the slots. This taper is more pronounced in the embodiment of Figure 13.

Figure 14 depicts yet another embodiment of an ankle brace 10C, made in accordance with the present invention. In this embodiment, the left and right rearwardly projecting arms 32C, 34C do not overlap each other. A separate rear cuff member 38C does overlap these arms 32C, 34C. The rear cuff member may be made of a material that is more flexible than the material of the arms 32C, 34C, and it is pivotably secured to both of the projecting arms 32C, 34C via bolts, rivets, pins, or other connectors to form two rear pivot points 36C (See Figure 15). The rear cuff 38C provides a bridge between the two pivot legs 22C, 24C, and it allows some flexibility of lateral movement of the leg.

Figure 16 depicts another embodiment of an ankle brace 10D, made in accordance with the present invention. This embodiment is similar to the previous embodiment 10C in that the left and right rearwardly projecting arms 32D, 34D do not overlap each other, and a separate rear cuff member 38D does overlap these arms 32D, 34D and it is secured to both of the projecting arms 32D, 34D via bolts, rivets, pins, or other connectors. In this embodiment 10D, the rear cuff member 38D

is preferably made from a more flexible material than the pivot legs 22D, 24D, and it is this flexibility of the material of the rear cuff 38D that allows more lateral movement of the leg than would otherwise be available if the cuff had the same flexibility as the rest of the brace.

Figures 17-21, 28, and 28A show another embodiment of an ankle brace 10E made in accordance with the present invention. Figures 22, 23, 27, and 29 show still another embodiment 10F. Figures 24-26 show a strap being mounted on either of the embodiments 10E or 10F.

Figures 17-21 show an ankle brace 10E made in accordance with the present invention, with the closure strap removed for clarity. The ankle brace 10E includes a substantially U-shaped heel stirrup 112 with a bottom portion 114 and left and right upright portions 116, 118, which project upwardly and are pivotally connected to left and right pivot legs 120, 122, respectively. The left and right pivot legs 120, 122 have left and right arms 124, 126, which are joined together to form a rear cuff 128. In this embodiment, the rear cuff 128 is a single, continuous piece and does not provide the flexibility of other embodiments. (In the other embodiment 10F, shown in Figure 22, the rear cuff is formed of two pieces which are connected together at a pivot 130 as in the case of the first embodiment 10 shown in Figure 1)

The two arms 124, 126 are essentially mirror images of each other, and the cuff 128 is symmetrical along an imaginary axis, forming a generally horseshoe-shaped profile which wraps around the back of the wearer's leg as shown in Figure 17.

Near the front edge 132 of the left arm 124 is a U-shaped, forwardly-projecting, generally vertical post 134, which is connected at its top and bottom ends to the left arm 124. The central portion of the post 134 is outwardly spaced from the outer surface of the left leg 120, forming a vertical slot 136 between the post 134 and the outer surface of the leg 120, best shown in Figure 20. A similar post 144 is located in the same position near the front edge 142 of the right leg 122, defining a similar slotted opening 146. In this preferred embodiment 10E, the posts 134, 144 are integrally molded with the legs 120, 122. However, the ends of the posts 134, 144 may be secured to the legs 120, 122 by other substantially rigid means, such as bolting, riveting, and so forth.

The outer surface of the legs 120, 122 preferably is recessed in the area of the posts 134, 144 to help facilitate the passage of a strap through the slots 136, 146. The recessed portions of the legs 120, 122 forward of the posts 134, 144 are referred to as anterior strips 138, 148, and the recessed portions of the legs 120, 122 to the rear of the posts 134, 144 are referred to as posterior strips 140, 150. A narrow, vertical strip of hook Velcro 152 (See Figure 19) is secured, by any suitable means such as gluing, to the anterior strip 148 of the right leg 122.

A closure strap 154 is shown in Figures 24-29. The strap 154 has first and second ends 158A and 158B, and first and second surfaces 156, 158. The first surface 156 preferably is a smooth surface, at least for the portion that is in contact with the wearer's leg. The second surface 158 has loop Velcro beginning at the first end 158A and extending for approximately two-thirds of the length of the strap 154. The remainder of the strap 154 is a hook Velcro, extending all the way to the second end 158B of the strap 154. The width and thickness of the closure strap 154 is such that it can fit through the slots 136, 146 on the arms 126, 124 respectively. In this preferred embodiment, the strap is approximately two inches wide and 1/16-inch thick.

To use the ankle brace 10E (See Figures 24, 25, and 26), the first end 158A of the strap 154 is fed through the slot 146 on the right leg 122 of the brace 10E such that the loop Velcro on the Velcro side 158 of the strap 154 engages with the hook Velcro strip 152 on the anterior strip of the right leg 124. The strap 154 is then bent around the post 144 on the right leg 122 and is extended across the front of the brace 10E, until the second end 158B of the strap 154 is fed through the slot 136 on the left leg 120, going first along the anterior strip 138, then through the slot 136, and then out past the posterior strip 140, as shown in Figure 26. The smooth, fabric-like first side 156 of the strap 154 faces the wearer's leg. The user then folds the strap 154 over the post 134 on the left leg 120, and pulls the strap 154 tightly back onto itself so that the hook Velcro on the second side 158 adjacent the second end 158B of the strap 154 engages the loop Velcro on the remainder of the second side 158 of the strap 154. The brace 10E may be tightened or loosened by pulling more or less tightly on the second end 158B of the strap 154 after the strap 154 has been fed through the slot 136 and around the post 134.

Figure 28 shows one possible location of the strap 154, with a substantial portion of the first end 158A extending beyond the hook Velcro narrow strip 152 on the right leg 122. This would be for a person having a relatively small diameter ankle. Figure 28A shows another possible location of the same strap 154, for use with a larger ankle. In this case, the end 158A does not extend beyond the Velcro strip 152. The connection point between the strap 514 and the strip 152 may be adjusted to effectively lengthen or shorten the strap 154.

Since the posts 134, 144 are fixed securely at both ends to the body of the ankle brace 10E and are preferably made of the same or similar material to the rest of the brace, they provide substantial rigidity at both ends of the strap 154, which helps provide a secure fit between the person's leg and the ankle brace 10E.

The strap 154 is fed through the slots and around the posts 134, 144 of the other ankle brace 10F in the same manner as in the ankle brace 10E. The only difference is that the rear cuff of the second brace 10F includes a pivot 130.

Figure 30 shows another alternate embodiment of a brace made in accordance with the present invention. In this case, the legs 22E and 24E are pivotably connected to the heel stirrup as in previous embodiments, and arms 32E, 34E project rearwardly from their respective legs and join to form a flexible rear cuff. In this embodiment, the arms 32E, 34E and the legs 22E, 24E are all made as a single piece. The height of a central portion of the rear cuff has been substantially reduced to form a flexible web 60, which provides the desired structural support and flexibility to the brace.

It will be obvious to those skilled in the art that modifications may be made to the preferred embodiments described herein without departing from the scope of the present invention.